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ABSTRACT

This article presents various solutions to possible problems associated with providing skill-based instruction in physical education. It explores and applies Newell's (1986) constraints model to the analysis and teaching of motor skills in physical education, describing the role of individual, task, and environmental constraints in physical education. It goes on to discuss the application of constraints to the use of an appropriate teaching style that promotes the development of motor skill progressions among all learners. The paper focuses on use of the inclusion style of teaching (Mosston & Ashworth, 2002) for adapting both the task and environment to individual constraints and varying skill levels in physical education. It explains how a task sheet is often used to instruct students on the different choices available in a motor skill lesson. The task sheet offers various choices of task or environmental constraints for the learner. Challenges to using the inclusion style is that sometimes students are unrealistic about which level is most appropriate for them on the task sheet, and sometimes they need guidance on determining whether or not they meet the criteria for the motor skill. A sample task sheet on the softball throw for accuracy is attached. (SM)

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Running Head: Constraints in Physical Education

Constraints of Motor Skill Acquisition: Implications for Teaching and Learning

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Abstract

Providing instruction on motor skills without a clearly defined process of developing progressions suited to the needs of the learner has been the subject of concern for many years. This article applies various solutions to the possible problems associated with providing skill-based instruction in physical education. Understanding the influence of constraints (Newell, 1986) in the teaching learning process can guide decisions on providing developmentally appropriate instruction. The inclusion style (Mosston & Ashworth, 2002) is presented as a possibility in adapting to constraints in task or environmental needs of the learner. Evaluation and providing feedback to students about their choices in developing skills can assist them in making realistic decisions about their appropriate level of task or environmental constraints.

Constraints on Motor Skill Acquisition: Implications for Teaching and Learning

The development of competency and proficiency in many movement forms is an important content standard for all children in physical education class (NASPE, 1995). Unfortunately, many physical education teachers provide instruction without a clearly defined process of developing motor skill progressions suited to the needs of learners. Consequently, many children do not learn basic motor skills or movement forms to be considered 'competent' or 'proficient' in physical education.

The purpose of this article is twofold: First, the authors will explore and apply Newell's (1986) constraints model to the analysis and teaching of motor skills in physical education. Specifically, the authors will discuss the role of individual, task, and environmental constraints in physical education. Secondly, authors will discuss the application of constraints to the use of an appropriate teaching style that promotes the development of motor skill progressions among all learners. The use of the *inclusion style of teaching* (Mosston & Ashworth, 2002) will be discussed to adapt both the task and environment to individual constraints and varying skill levels in physical education.

Constraints in Physical Education

Newell (1986) proposed a model explaining how motor skills are influenced or acquired. The constraints model, suggested by Newell, states that motor skills arise from the interaction of three primary constraints. Although, a constraint is often defined as a barrier, it is not always the case according to this model. A constraint, according to Newell, is any task, environmental, or individual-related factor that shapes or influences the outcome of movement or motor pattern that is observed. In fact, it is the interaction of these factors that helps to determine the developmental pattern of movement that a

learner will display in a motor skill task. Constraints may be limiting factors, or they may be factors that facilitate movement. Newell's model is illustrated in Figure 1.

Insert Figure 1 here

Individual constraints. Individual constraints are factors that are a person's own unique physical, mental characteristics, and attributes that influence movement. These factors can be structural or functional (Haywood & Getchell, 2001). Structural constraints are factors that have to do with our biological make up and growth processes include factors related to height, weight, strength, hand size, limb length, and body composition. Functional constraints are individual factors that contribute to our behavioral make up. These factors can include functional characteristics such as attention or motivation or can include more enduring personality traits such as anxiety or tenacity.

Structural and functional constraints can change quickly, slowly evolve, or they can be relatively stable characteristics that persist throughout childhood and into adulthood. Structural constraints may also change at different rates during childhood and adolescence. For instance height, a structural constraint, changes slowly during childhood at a stable rate until adolescence when growth rate changes tremendously. Functional constraints, such as motivation, can change quickly or can be thought of as more enduring personality characteristics such as an individual's tenacity that persist over time.

The learner can modify or alter some types of structural constraints. For instance, weight and body composition, are structural constraints that are modified largely by diet and the amount of physical activity of the individual. Other structural constraints, such as height are difficult, if not impossible, for the learner to change. Functional behavioral constraints such as attitude and motivation are easily altered by the learner, whereas, other functional behavioral constraints such as trait anxiety, although not impossible, are more difficult to change for the individual.

It is important for the physical education teacher to understand the influence of individual constraints on motor skill acquisition. Both structural and functional constraints can influence motor performance on a number of skills. For instance, a structural constraint such as strength, can positively or negatively impact force production tasks (e.g., throwing, striking, kicking). Other functional constraints such as attitude and motivation will influence participation in many tasks in physical education.

Task constraints. Task constraints include the goals, rules, and equipment that are used to perform a motor skill. Some task constraints influence the nature of the lesson that is taught and selected by the physical education teacher prior to teaching. Other constraints are influenced by external factors such as regulations in a game or sport. Any of these factors can be manipulated or changed by the physical education teacher to make an activity more developmentally appropriate for children.

Task constraints may be viewed as the movement outcomes or goals for various motor skills during a lesson, activity, sport, or game. Movement outcomes emphasized include various factors such as distance, accuracy, speed, and force. Each of these movement goals result in very different types of motor patterns or responses from the

learner. For instance, a teacher focusing on the skill of throwing may emphasize distance or accuracy as a movement outcome during a physical education lesson. The throwing pattern in each instance would look very different.

Rules may constrain or enhance motor performance on some tasks. Rules and regulations in sports and games often govern the dimensions and size of factors such as the playing area. In sports such as basketball, these factors can include net height, distance between court lines, and point value for shots from various distances. Rules in basketball govern factors such as the number of steps an individual can take before shooting, or pivoting. Rules in volleyball can specify how many times a ball can be legally hit before going over the net.

Changing the rules of a sport or activity can often influence or manipulate the movement pattern that is observed. Many physical education teachers are familiar with the underhanded free throw shot in basketball used by children who do not have sufficient strength or height. Making a minor change in basketball to lower the height of a basketball goal can positively impact the motor pattern in children who do not have the strength or height to propel the ball sufficiently to hit the basket from a regulation height.

The use of equipment in a motor skill is also an important constraint to consider in motor performance. Equipment considerations include factors such as size, weight, and material of balls and other implements that are used in an activity, lesson, or sport. For example, in a lesson on catching, a ball that is made of a hard material may cause the learner to turn their head away from the ball to avoid getting hit. A ball that is easy to grasp with the hands and is of a cushiony material may best facilitate two-handed catching with the hands for development in this skill.

It is important to understand the relationship of the task constraint to individual constraints in physical education. For instance, ball size itself may not be the critical factor in determining motor performance in the skill of catching. A much more important factor may be ball size and its relationship to the hand size of the performer. It may be very difficult for a child with small hands to catch a very large ball without cradling the ball to the chest. A critical factor in throwing may be distance, but more importantly, distance in relationship to the height of the performer may be more important in determining movement outcomes in overhand throwing (Hamilton & Tate, 2002).

Environmental constraints. The environment may have *physical* and *social* dimensions that act to constrain or influence motor skills. Physical constraints include immediate geographical features of the environment such as terrain, water, air circulation, and lighting (etc.). These physical factors enhance or inhibit performance on a number of movement tasks. For instance a smooth asphalt terrain or surface area may facilitate a locomotor skill such running, whereas, a sandy terrain or area may slow down the running process or make it more difficult.

Social constraints include factors such as the level of interaction or type of interaction that is present in a task in physical education. Children can be required to participate in an activity individually, with a partner, or group of individuals. Each of these situations would require a different level of interaction with other children. In some cases working with a partner or group can facilitate learning, whereas in other cases working individually may be more appropriate.

The type of interaction required in an activity may also constrain motor skills. Cooperation, self-competition, and competition are all means of social interaction that

may produce different motor skill results. For instance, consider the effect of adding competition to a lesson in physical education. In some cases, competition may improve motor skill performance, whereas in other cases, competition causes decrements in performance. It is important for the physical education teacher to be aware of the differential effects of adding competition or cooperation into a lesson on physical education.

Instructional Styles

Providing effective instruction to a diverse group of learners requires an understanding of Newell's constraints model (i.e., individual, task, and environment) to the application of various teaching styles. Mosston and Ashworth (2002) have provided a comprehensive framework that is used by many teacher educators and physical education teachers in the field of physical education. *The Spectrum of Teaching Styles* is a framework of instructional models that is based on teacher and learner decision-making. The initial work, published by Mosston (1966), now in its fifth edition, looks at the role of the teacher, the learner, and content in the teaching process. Mosston and Ashworth (2002) identified several teaching styles in the spectrum that are identified by letters (A-K). Each of the styles in the spectrum varies in the amount of decision-making by the teacher and the learner. According to Mosston and Ashworth, the teaching styles vary in their underlying purpose. Several of the teaching styles are deemed most appropriate for the acquisition of motor skills. Other styles in the spectrum emphasize the process of discovery of solutions to problems and movement scenarios. In each of the teaching styles, Mosston and Ashworth define the role of the teacher and the learner.

A hallmark characteristic of the spectrum is the ability to shift focus in decision-making process from teacher to learner. Some of the styles of teaching in the spectrum are very teacher-centered. Other styles are more-learner centered when it comes to making choices. In physical education, both styles can be appropriate depending on the content, goal of the lesson, and the characteristics of the class.

If the goal is to accommodate every child in the learning of motor skills, then the teacher will want to shift some of the decision-making and choices to the learner. These choices can focus on task constraints (i.e. goals of movement, rules, equipment) or environmental constraints (i.e. physical or social). Providing a wide range of student choices in the task and environment can help to accommodate varying levels of proficiency and competence among students. The *inclusion style* (Mosston & Ashworth, 2002) is designed to teach children with a variety of *individual constraints* and skill levels. The role of the teacher in this style is to make prior decisions about the task or environmental constraints used in the lesson.

To facilitate the inclusion style of teaching, a task sheet is often used to instruct learners on the different choices that are available in a motor skill lesson (see figure 2). The purpose of the task sheet is to provide various choices of task or environmental constraints for the learner. The task sheet (figure 2) illustrates the skill of throwing used in teaching a lesson in physical education using the inclusion style (i.e. style E) of the Spectrum.

Students using this task sheet (figure 2) would read the criteria listed for performing the overhand throw for accuracy. After reading and understanding criteria, students would choose the size of target (e.g., large vs. small target) and distances that

are (10ft, 20 ft, 30 ft). In the task sheet illustrated, the student would determine if they met the criteria for the overhand throw. Students would then circle the number of times that they were able to accurately hit the target out of ten trials. Students could then decide on the program sheet if they wanted to move to a higher level.

A unique feature of the task sheet is that it provides flexibility in varying the level of task constraints. Instead of focusing on accuracy, a teacher providing instruction on the overhand throw could focus on distance, or even speed. Teachers could also provide choices on the different types of balls (i.e. weight, material, size) for the overhand throw to make the skill more or less challenging.

A task sheet could also be used to vary the environmental (e.g., physical or social) constraints. For instance, in the skill of running, teachers could provide choices on not only the distance, but also the type of surface that students choose to run on during the lesson. Teachers could provide choices about social constraints by allowing students to participate with another individual or alone.

One challenging aspect of using the inclusion style is that students are sometimes unrealistic about deciding which level is most appropriate for their skill level on the task sheet. A second challenge is that students may also need guidance on determining whether or not they met the criteria for the motor skill. Teachers can provide assistance by spot-checking students on the criteria provided and guide them to making realistic decisions while monitoring student performance. In addition, teachers should note that the task sheet can be used in two ways: (a) an individual prescriptive program that identifies entry and starting points for students, or (b) student choice, whereby students determine the appropriate level at which they want to participate.

In conclusion, developing sequential progressions in motor skills requires a systematic process. Newell's constraints model can provide a conceptual framework for teachers to analyze and adapt motor skills to meet the needs of individual learners. Understanding the influence of task, environment, and individual in the teaching-learning process can guide decisions on providing developmentally appropriate instruction.

The inclusion style (Mosston & Ashworth, 2002) may be used as a means of adapting constraints in the task or environment to the needs of the learner. Teachers can effectively design task sheets in which students choose the appropriate level of task or environmental constraints to match their skill level. Monitoring and providing feedback to students about their choices can assist students in developing realistic decisions about the appropriate level of task or environmental constraints.

Table 1. Motor Skill Constraints

Task Constraints	Examples
Goals of the motor skill task	distance, accuracy, speed
Levels of difficulty of the task	sizes of target, distances required, speed
Equipment available	balls of varying sizes, weights, materials
Rules	net height, number of hits allowable
Individual Constraints	**Examples**
Structural	height of individual, weight of individual, body composition, hand size
Functional	attention, motivation, tenacity
Environmental Constraints	**Examples**
Physical	terrain, water, air circulation
Social	individual participation, group participation, cooperation, competition

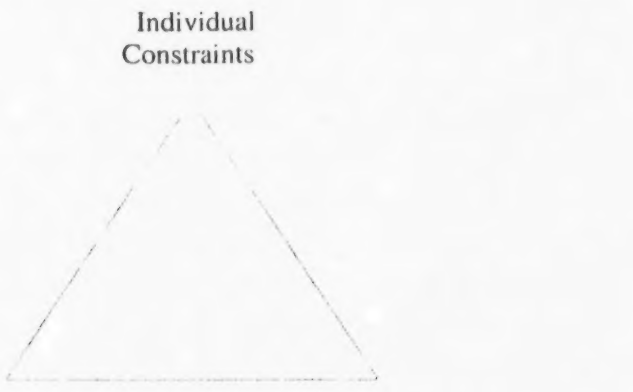

Figure 1. Newell's model of constraints

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Name: _____ Style A B C D E

Class: _____ Individual Program #_____

Date: _____

Softball Throw For Accuracy

Student Tasks:

1. Select the distance level and number that you expect to accomplish
2. Practice throwing for accuracy and place an X over the trial number when you hit the target.
3. Compare your performance on accuracy with your performance criteria.
4. Decide if you should repeat the test at the same level or at a different level.

Criteria In Throwing For Accuracy:

1. Stand with body perpendicular to target and throwing arm furthest away from target.
2. Slightly bend your knees while in the ready stance.
3. Throw the ball overhand while stepping with you lead leg toward the target.
4. Follow through after the release of the ball, shifting your body weight to the front leg.
5. Refrain from aiming the ball, or throwing with only your arm. Step, rotate your body and throw the ball in a smooth sequence.
6. The flight of the ball should be thrown in a straight path.

The Task: Choose a distance (10' , 20', or 30') and one of the targets (either large or small). Take ten throws and record the number of times you hit the target area.

10 Feet _____
20 Feet _____
30 Feet _____

Distance	Larger Target									
10 Feet	1	2	3	4	5	6	7	8	9	10
20 Feet	1	2	3	4	5	6	7	8	9	10
30 Feet	1	2	3	4	5	6	7	8	9	10

Distance	Smaller Target									
10 Feet	1	2	3	4	5	6	7	8	9	10
20 Feet	1	2	3	4	5	6	7	8	9	10
30 Feet	1	2	3	4	5	6	7	8	9	10

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